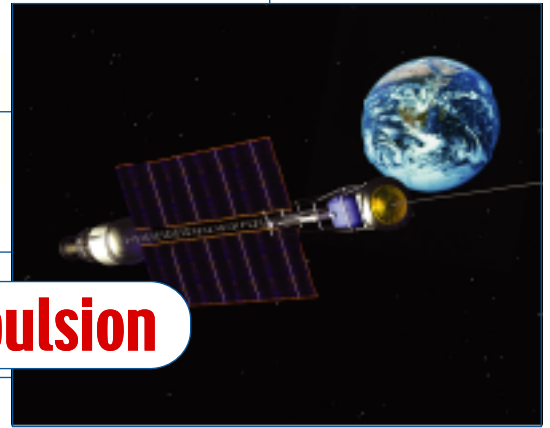


Advanced Space Transportation Technology Summary



Momentum-Exchange Tether Propulsion

NASA's Marshall Space Flight Center in Huntsville, Ala., is developing experiments to show that tether-based propulsion – which requires no on-board propellant but instead draws power from the near-Earth environment – could dramatically reduce the cost of raising and maintaining the orbits of other spacecraft, including communications satellites and probes destined for the outer planets of our solar system.

Using the scientific principle of “momentum exchange” – the action of transferring momentum from one body to another – tether propulsion systems provide a viable alternative to traditional chemical propulsion systems, enabling a variety of missions along the highway to space.

By briefly linking a slow-moving object with a faster one, the slower object's speed may be dramatically increased as some of its counterpart's momentum is transferred to it – much the way ice skaters play “crack the whip” to launch one another at high speed across the ice. Similarly, a spinning, tether-based satellite in low Earth orbit might snare slower-moving objects and hurl them at increased speed toward higher orbits.

Researchers at the Marshall Center are developing the “Momentum Exchange, Electrodynamic Reboost” tether propulsion system, or MXER, which would use momentum exchange to transfer satellites from low-Earth orbit to geosynchronous orbit – a fixed orbit roughly 22,300 miles (36,000 kilometers) above the equator – and beyond. MXER also would employ electrodynamic reboost to maintain its own elliptical orbit: an oblong circuit that would bring MXER to within 248 miles (400 kilometers) of Earth at perigee, or its nearest point, and shoot out to more than 4,970 miles (8,000 kilometers) at apogee, or its farthest point.

Intended for launch by rocket to a circular low-Earth orbit, MXER would deploy a 93-mile-long (150 kilometers) tether that uses a combination of electrical current and gravity to put the tether into a tight spin, altering its orbit into an elliptical pattern. As communications satellites and other high-orbit payloads are launched by rocket into low-Earth orbit, they could rendezvous with MXER, which would “snare” them via a net-like catch mechanism and hurl them toward their final destination – without the need for the costly, fuel-heavy upper-stage booster rocket usually associated with the climb to geosynchronous orbit.

And because MXER would remain in orbit, repeating its orbital transfer duties throughout its lifespan, it could greatly reduce costs associated with upper-stage rockets, which normally fall back into the atmosphere and burn up after a single use.

A tether-based propulsion system such as MXER could be flying in 10-15 years, raising or lowering satellites or deep-space probes for scientific and engineering purposes, and boosting commercial satellites to geosynchronous orbit. Some forward thinkers among NASA's industry partners are already developing ways to use the technology to cheaply and efficiently transport payloads beyond low-Earth orbit – paving the way for an eventual human return to the Moon, as well as journeys to Mars and the outer planets.

NASA's MXER technology development team includes the University of Illinois at Urbana-Champaign, Tennessee Technological University in Cookeville, and Tethers Unlimited of Lynnwood, Wash.

The MXER experiment is managed by the Marshall Center's Advanced Space Transportation Program, which is paving the highway to space by developing innovative technologies to dramatically reduce the cost of space transportation.

For more information about space tethers and their potential applications, visit
<http://www.tethers.com>

For more information about NASA Space Transportation Systems, visit
<http://www.spacetransportation.com>